

AD-A138 594

STABILITY CALCULATIONS FOR ARAPAHO FEASIBILITY
DEMONSTRATION(U) HENRY (J J) CO INC ARLINGTON VA
P J PIERCE 01 SEP 82 N00019-82-M-0323

1/1

UNCLASSIFIED

F/G 13/10

NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

J. J. HENRY CO. INC.

NAVAL ARCHITECTS • MARINE ENGINEERS • M.A.

ONE CRYSTAL GATEWAY
1235 JEFFERSON DAVIS HWY.
SUITE 1305
ARLINGTON, VIRGINIA 22202
703-920-3435

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File 2064 00/FYM-3.0
9/9/82

Commander
Naval Air Systems Command
Department of the Navy
Washington, D.C. 20361

Attention: Mr. J. J. Mulquin
NAVAIR ADPO-15

DTIC
ELECTE

OCT 31 1983

N00019-82-M-032

Dear Sir:

J. J. Henry Co., Inc. (JJH) has completed a review of ARAPAHO as it would be configured for the upcoming feasibility demonstration aboard C5-S-73b (Export Leader) container ships, as requested. This review has included contact with the U.S. Coast Guard, the Maritime Administration (MARAD), the Norfolk International Terminal, and a visit to the ARAPAHO system on site at NAEC in Lakehurst, New Jersey. The Coast Guard has indicated that they will inspect the vessel at the request of MARAD, but will not issue a Certificate of Inspection. During this inspection, the requirements of Title 46 CFR, Parts 90 through 109, will be applied. They also desire a demonstration schedule, so traffic problems in the area can be avoided.

The C5-S-73b ships will be compatible with ARAPAHO for the feasibility demonstration. Visibility for the ship's officers from the navigation bridge will be adequate, as the entire ARAPAHO system will be aft of the forward house. Deck area and load capacity are sufficient for the intended application, and stability is satisfactory. Metacentric height (GM) should be approximately 8.5', compared to the minimum requirement of approximately 4.0'. It is anticipated that the mean draft of the ship during the demonstration will be about 15'-2", with a trim of 9'-1" by the stern, which provides a trim angle of less than 1.0%. Additionally, loading of the ARAPAHO aboard this class of ship in its light condition at the Norfolk International Terminal will remain unhampered by vertical clearances at any stage of the tidal cycle. The above considerations indicate that the physical properties of the ARAPAHO/ship class combination will be acceptable for the feasibility demonstration. Seakeeping characteristics of the vessel should not be of major concern since the demonstration is going to be conducted in protected waters (the Chesapeake Bay). According to statistical meteorological data, the normal average wind speed during the month of October is on the order of 10 miles per hour. The waves associated with this wind are 1 to 2 feet high. For the size of the ship and its motion characteristics, this will not cause any significant problem. The natural period of roll was estimated at 12.0 seconds and the natural period of pitch was estimated to be on the order of 16.0 seconds. With these natural period parameters, only swells above 8 to 10 feet in height would cause significant ship's motions.

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AD A 138594

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This review has also considered supporting systems. It is advised that the plan to use two tugs for the feasibility demonstration be retained. Safety considerations dictate that both tugs remain in constant radio contact with the pilot and master on the demonstration ship's navigation bridge, and that the tug not involved in the towing operation maintain a vigilant watch on station nearby for rescue operations or emergency maneuvers. Internal communications systems and ship's radio must provide contact between the navigation bridge and the following areas, as planned: tugs, machinery spaces, anchor watch area, helicopter control station, both after and forward houses, D.C. Central, and other vessels in the area. As a minimum, the ship's radio should be operational and in compliance with Title 33 of the Code of Federal Regulations (CFR) Part 26, and Title 47 CFR, Parts 81 and 83. The proposed firefighting systems seem adequate. Review of correspondence by Cerberonics, Inc. indicates that CO₂ flooding will not be available in the machinery spaces. Particular caution must be exercised in the protection provided this area. The general alarm system should be fully operational. The fuel farm and its connections and hoses are not in compliance with Coast Guard regulations for commercial vessels, so caution must be exercised here also. The ARAPAHO system will be prone to spills of the JP-5 because no provision has been made for spill containment or periodic shut-off valves in the lines to isolate possible ruptures. It is assumed that lifesaving equipment will be provided in quantity and location as required by the Coast Guard and as detailed by Title 46 CFR, Part 94. In the area of accommodations, the Coast Guard requires that all systems be activated. This includes: ventilation, air conditioning, lighting, fresh water, sanitary water, the general alarm system and firefighting.

Some areas of potential risk to the success of the ARAPAHO feasibility demonstration are listed below. These are not considered to have a major impact on the tests to be conducted in the Chesapeake Bay, but are presented here to complete the review.

- a. Safety Nets - should be used around the edge of the landing area during the feasibility demonstration.
- b. Escape Routes - NAEC personnel have expressed concern that some modules have only one access.
- c. Electrical Power Distribution Center - Moisture present in this module may be the cause of short circuits which have occurred. The solution may be to install dehumidification equipment.
- d. Fuel Handling - no provision has been made for spill containment or isolation of leaking sections of rubber hose, as mentioned above.
- e. Lashing System - the lashing arrangement was not entirely in place for JJH review. Therefore we cannot comment on the adequacy of the lashing system.




att sample

Apr 23

(100-2812)
It is concluded that,
In conclusion, as far as naval architectural aspects are concerned, the ship "Export Leader" is matched to the purpose intended and the demonstration should be technically sound and effective.

Very truly yours,

J. J. HENRY CO., INC.



G. R. Jones
Manager

FYM/kc

Stability Calculations for
ARAPAHO Feasibility Demonstration

Prepared by:

J.J. Henry Co., Inc.
Suite 1305
1235 Jefferson Davis Highway
Arlington, VA 22202

Prepared:

P. J. Reese

Checked:

J. Y. Michael

September 1, 1982

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ARAPAHO (SEAWATCH CONFIGURATION)

- No Accommodation Modules
- Forward Fuel Farm

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REF LINE FOR V.C.G. _____

REF LINE FOR LCG _____

COMPARTMENT	CU FT TON	WEIGHT TONS	VCG ABV. BL FT	MOMENT ABV. BL FT TONS	LCG ABT. FP FT	MOMENT ABT. FP. FT TONS	VERT OF I FT TO
ARAPAHO Test Modules		722.7	64.47	59,946.34	275.09	253,322.53	14
Forward Ula's		60.0	39.09	2,344.8	462.50	27,750.0	117
Forward Abseilers		6.0	64.0	384.0	225.0	1,370.0	
DEADWEIGHT		988.7	63.59	62,675.14	222.63	283,242.4	12
LIGHT SHIP		10,364.0	25.43	267,702.12	213.21	2,216,108.4	
DISPLACEMENT		11,352.7	29.10	330,577.26	210.99	2,402,410.0	12

TRIM

DRAFT AT LCG = 15.16 FT
 MOMENT TO ALTER TRIM 1" = 1792 FT-TS
 LCB AFT OF FP = 203.73 FT
 LCG AFT OF FP = 310.89 FT
 TRIMMING LEVER = 17.16 FT
 TRIM = 9.06 FT
 LCF AFT OF FP = 277.10 FT
 DRAFT AT FP = 10.53' AP = 19.59'

DRAFTS AT DRAFT MARKS

FWD = 10' 7 1/4" AFT = 18' 9 1/8"

midship works MEAN = 15' 1 1/2"

STABILITY

METACENTRE ABOVE BL KM = 37.70
 CENTRE OF GRAVITY ABV BL KG = 29.10
 METACENTRIC HEIGHT GM = 8.60
 ALLOWANCE FOR FREE SURFACE = .01
 GM CORRECTED = 8.59
 GM REQUIRED (MAX. WREST CASE) = 3.95
 MOMENT TO HEEL 1° = 1,702 FT

J.J. HENRY CO. INC.

NAVAL ARCHITECTS-MARINE ENGINEERS
 NEW YORK PHILADELPHIA

Naval Architects and Marine Engineers

SUBJECT SUMMARY OF WEIGHTS & CENTERS

J. O. NO. _____
SHEET NO. 2 OF 19
DATE 8-21-32
COMP. BY FJC C'KD BY _____

MODULE	WEIGHT IN LONG TONS	VCG	VERTICAL MOMENTS	LCG	LONGITUDINAL MOMENTS
Fuel Payer	6.13	63.15'	4,049.81	542.42'	34,795.73
01 Load	510.05	59.90'	30,552.0	227.21'	131,591.0
02 & 03 Load	240.97	69.58'	16,754.86	193.35'	46,573.09
04 & 05 Load	107.65	79.75'	8,584.67	175.69'	22,872.71
TOTALS	922.70	64.97'	59,946.34	275.09'	233,822.58

Naval Architects and Marine Engineers

J. O. NO. 2064-00
SHEET NO. 3 OF 19
DATE 6-30-32
COMP. BY PJP C'K'D BY _____

[illegible]

J. J. HENRY CO., INC.

Naval Architects and Marine Engineers

NAME OF COMPANY ARAPAHO Stability & Trim
 SUBJECT 01 Large Modules & Adapters

J. O. No. 2064-C
 SHEET No. 4 OF 19
 DATE 3-31-52
 COMP. BY ESP C.K'D BY _____

MODULE	WEIGHT IN LONG TONS	VCG	VERTICAL MOMENTS	LCG	LONGITUDINAL MOMENTS
01-OP Modules	55.01	59.9'	3,295.1	429.0'	23,577.24
01-MH Modules	59.46		3,561.65	386.7'	22,969.4
01-KL Modules	59.79		3,581.42	339.5'	20,292.11
01-IJ Modules	54.8'		3,232.52	295.5'	16,193.40
01-GH Modules	62.64		3,752.14	249.00'	15,597.36
01-EF Modules	59.42		3,559.26	206.03	12,245.27
01-CD Modules	58.93		3,529.91	159.11'	9,379.39
"NO" Adapters	20.0		1,198.0	407.65'	3,153.0
"LM" Adapters	20.0		1,198.0	362.90'	7,258.0
"JK" Adapters	20.0		1,198.0	317.50'	6,350.0
"HI" Adapters	20.0		1,193.0	272.25'	5,445.0
"FG" Adapters	10.0		599.0	227.54'	2,275.4
"DE" Adapters	10.0	59.9'	599.0	182.65'	1,826.5
TOTALS	510.05	59.90	30,552.0	297.21	151,591.0

J. J. HENRY CO., INC.

Naval Architects and Marine Engineers

NAME OF COMPANY

1-100000 Stability & trim

J. O. NO.

SHEET NO.

OF

19

DATE

COMP. BY

CHECKED BY

SUBJECT

22-15 (Long) Modules (except Fuel Tank)
(No Accommodations)

MODULE	WEIGHT IN LONG TONS	VCG	VERTICAL MOMENTS	LCG	LONGITUDINAL MOMENTS
02-F6-6					
02-F6-5	41.95	65.15'	2,733.04	227.54'	9,545.3
02-F6-7					
02-DE-6					
02-DE-5	49.53	65.15'	3,226.88	132.55'	9,045.66
02-DE-7					
02-C-6					
02-C-5	23.84	65.15'	1,553.18	142.17'	3,556.21
02-C-7					
03-F6-6					
03-F6-5	50.18	73.65'	3,695.76	227.54'	11,417.96
03-F6-7					
03-DE-6					
03-DE-5	52.75	73.65'	3,335.04	182.63'	9,633.73
03-DE-7					
03-C-6					
03-C-5	22.62	73.65'	1,665.96	149.17'	3,374.23
03-C-7					
TOTALS	240.87	69.58'	16,759.26	193.35'	46,513.09

Naval Architects and Marine Engineers

J. O. NO. 2061-00
SHEET NO. 6 OF 19
DATE 3-21-60
COMP. BY SP C.K'D BY _____

MODULE	WEIGHT IN LONG TONS	VCG	VERTICAL MOMENTS	LCG	LONGITUDINAL MOMENTS
04-FG module	18.0	78.78'	1,413.04	227.5'	4,095.0
04-DE module	18.0	78.78'	1,413.04	182.65'	3,287.34
04-C module	9.0	78.78'	709.02	142.17'	1,342.53
05 Land module	62.65	80.44'	5,039.51	193.9'	12,147.31
TOTALS	107.65	79.75	8,584.67	193.89	20,872.71

J. J. HENRY CO., INC.

Naval Architects and Marine Engineers

NAME OF COMPANY ARAPAHOE stability & trim

SUBJECT Draft & Trim calcs

J. O. NO. 2264-02

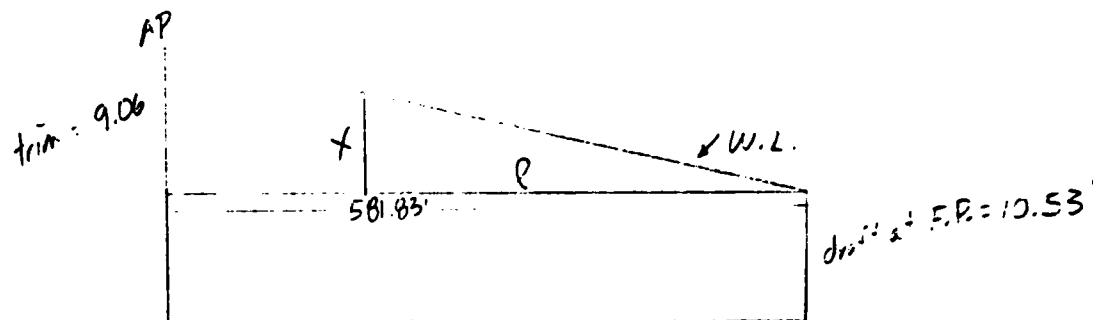
SHEET NO. 7 OF 12

DATE 9-1-55

COMP. BY PCP C.K'D BY

to solve for draft at any distance "L" from F.P.

(Use similar triangles)



$$\text{desired draft} = 10.53' + x$$

$$\text{and } \frac{L}{581.83'} = \frac{x}{9.06'} \quad , \quad x = \frac{(L)(9.06)}{581.83'}$$

so draft at any distance "L" from F.P. =

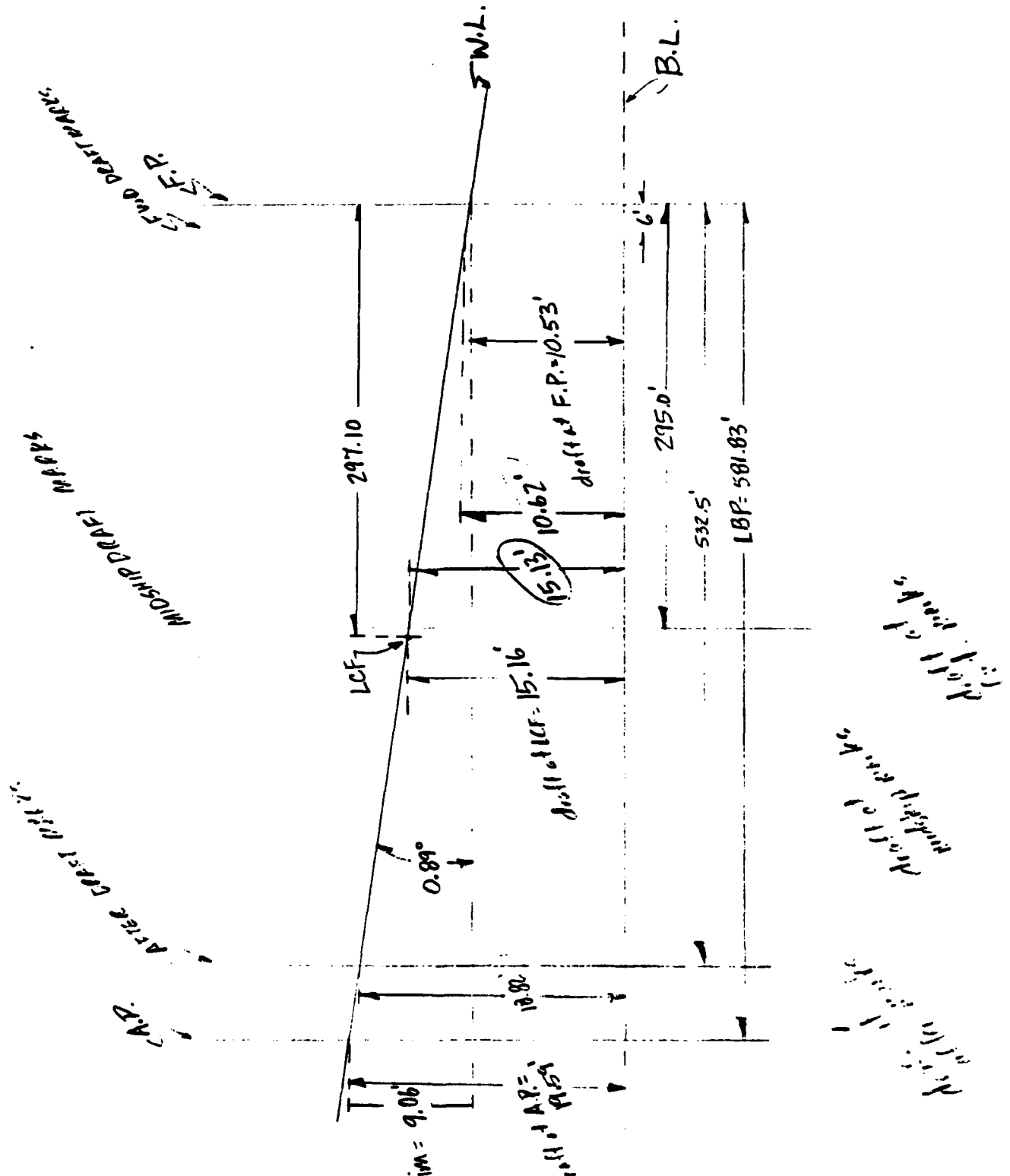
$$\frac{(L)(9.06)}{581.83} + 10.53'$$

Angle of trim

$$\text{Angle of trim} = \arctan \left(\frac{\text{trim}}{LBP} \right) = \arctan \left(\frac{9.06}{581.83'} \right) = 0.392^\circ$$

Naval Architects and Marine Engineers

J. O. No. 2084-0-0
SHEET NO. 8 OF 19
DATE 1-1-52
COMP. BY W. R. C'K'D BY



J. J. HENRY CO., INC.

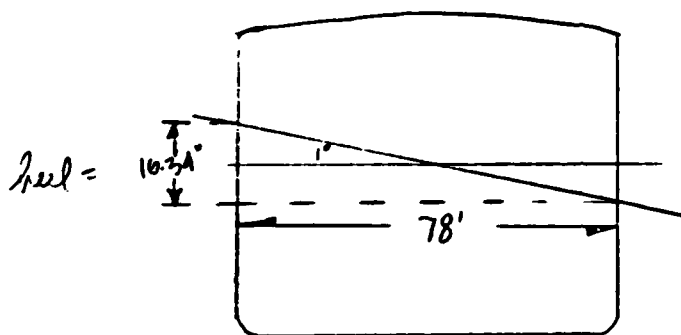
Naval Architects and Marine Engineers

NAME OF COMPANY ARADCO Stability & Trim
 SUBJECT Stability Codes

J. O. No. 2064-00
 SHEET No. 9 OF 19
 DATE 9-1-32
 COMP. BY PJP C.K'D BY _____

Moment to heel 1°

$$\text{moment to heel } 1'' = \frac{\Delta GM_T}{12 B} = \frac{(11,352.7 \text{ tons})(8.59 \text{ ft})}{(12)(78 \text{ ft})} = 95.13$$



correcting to heel 1 inch
10° heel in inches

$$\text{Moment to heel } 1^\circ = (104.18 \text{ ft. tons}) (16.34'') = 1,702 \text{ ft.-tons}$$

— or —

$$\text{Moment to heel } 1^\circ = (\Delta)(GM \sin 1^\circ) = (11,352.7)(8.59 \sin 1^\circ) = 1,702 \text{ ft.-tons}$$

FREE SURFACE

(assuming one fuel tank slack)

$$\text{increase in vert. moment} = \frac{I}{S} = \frac{(20)(8)^3}{12} = 19 \text{ ft.-tons}$$

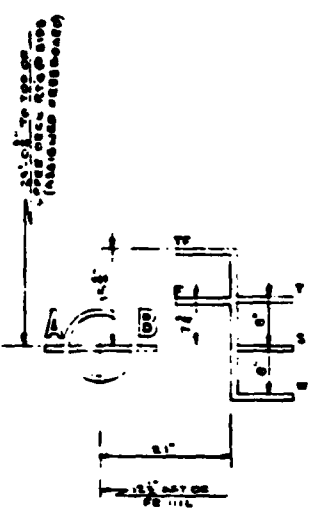
moment of inertia = 49.1 ft⁴/ton

also assume a slack port tank = 117 ft.-tons from ship. docs.

$$\text{free surface correction} = \frac{\text{vertical to}}{\Delta} = \frac{(19 + 117 \text{ ft.-tons})}{11,352.7} = .01 \text{ ft rise in K's}$$

2064-00
Sheet 100 19
9-1-52 JSP

KEEL DRAFT FEET	DISPLACEMENT TONS SEA WATER	DEAD- WEIGHT L. TONS	KM FEET	MOMENT TO TERN ON INCH	TONS PER INCH DRAFT	KEEL DRAFT FEET
20	15000					20
21	16000					21
22	17000	16243		1300	87	22
23	18000	16999		1300	86	23
24	19000					24
25	20000	17755		1300	85	25
26	21000					26
27	22000	18511		1300	84	27
28	23000					28
29	24000	19267		1300	83	29
30	25000					30
31	26000	20023		1300	82	31
32	27000					32
33	28000	20779		1300	81	33
34	29000					34
35	30000	21535		1300	80	35
36	31000					36
37	32000	22291		1300	79	37
38	33000					38
39	34000	23047		1300	78	39
40	35000					40
41	36000	23803		1300	77	41
42	37000					42
43	38000	24559		1300	76	43
44	39000					44
45	40000	25315		1300	75	45
46	41000					46
47	42000	26071		1300	74	47
48	43000					48
49	44000	26827		1300	73	49
50	45000					50
51	46000	27583		1300	72	51
52	47000					52
53	48000	28339		1300	71	53
54	49000					54
55	50000	29095		1300	70	55
56	51000					56
57	52000	29851		1300	69	57
58	53000					58
59	54000	30607		1300	68	59
60	55000					60
61	56000	31363		1300	67	61
62	57000					62
63	58000	32119		1300	66	63
64	59000					64
65	60000	32875		1300	65	65
66	61000					66
67	62000	33631		1300	64	67
68	63000					68
69	64000	34387		1300	63	69
70	65000					70
71	66000	35143		1300	62	71
72	67000					72
73	68000	35899		1300	61	73
74	69000					74
75	70000	36655		1300	60	75
76	71000					76
77	72000	37411		1300	59	77
78	73000					78
79	74000	38167		1300	58	79
80	75000					80
81	76000	38923		1300	57	81
82	77000					82
83	78000	39679		1300	56	83
84	79000					84
85	80000	40435		1300	55	85
86	81000					86
87	82000	41191		1300	54	87
88	83000					88
89	84000	41947		1300	53	89
90	85000					90
91	86000	42703		1300	52	91
92	87000					92
93	88000	43459		1300	51	93
94	89000					94
95	90000	44215		1300	50	95
96	91000					96
97	92000	44971		1300	49	97
98	93000					98
99	94000	45727		1300	48	99
100	95000					100



PLIMSOLL MARK
1 FOOT
TOTAL DISPLACEMENT (3400 - 26,070) @ 31-7 1/2 DRAFT
TONS DEADWEIGHT = 16,343

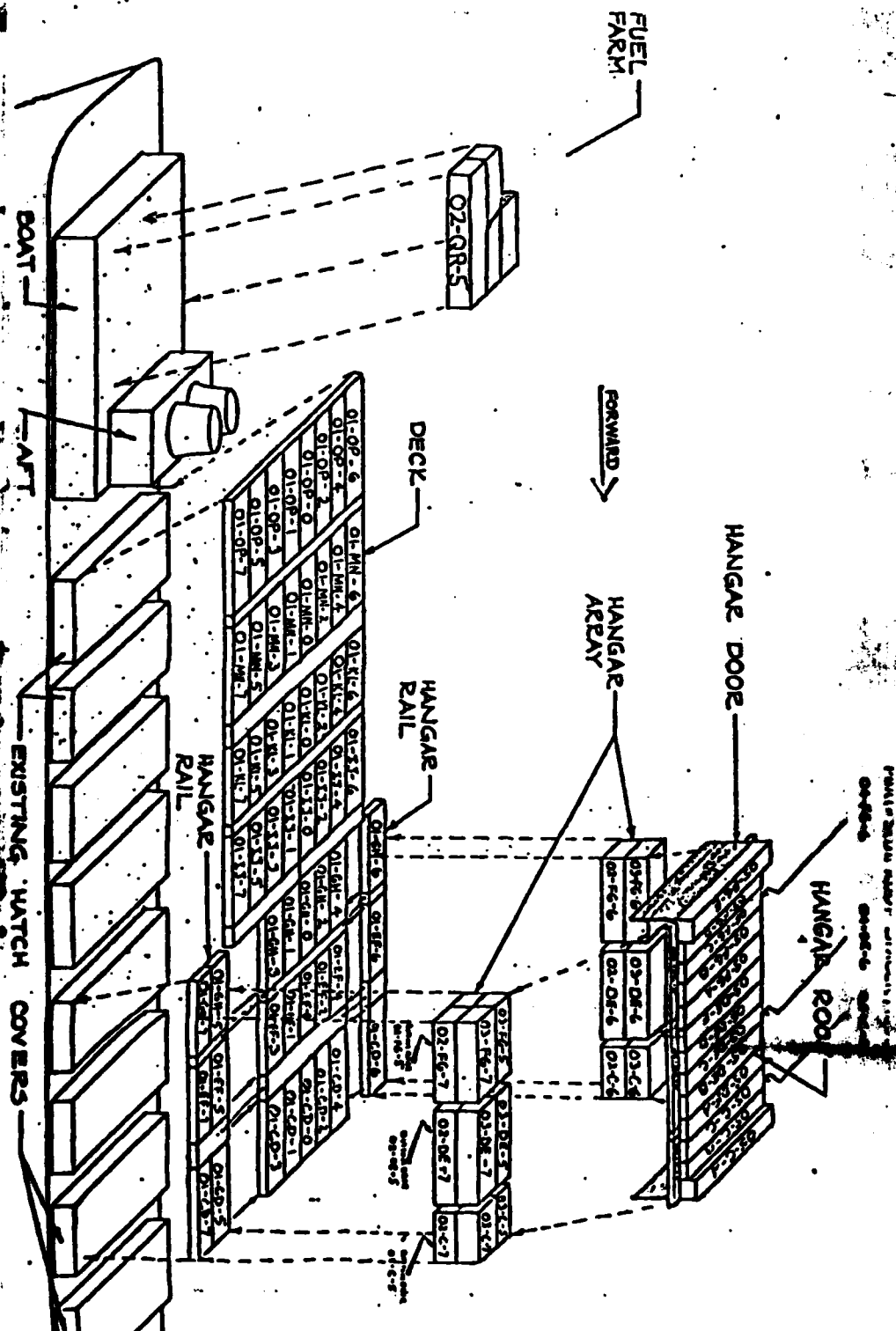
FUEL OIL			
TANK	FRAMES	CENTER OF GRAVITY VCG (ABT) LCG (ABT) IN	GALL WEIGHT
DEEP TANK NO. 1	P 33-51	12.98	84.75
DEEP TANK NO. 2	P 33-51	12.98	84.75
DOUBLE BOTT NO. 1	P 31-79	12.97	155.95
DOUBLE BOTT NO. 2	P 31-79	12.97	155.95
DOUBLE BOTT NO. 3	P 79-0	12.98	155.95
DOUBLE BOTT NO. 4	P 79-0	12.98	155.95
DOUBLE BOTT NO. 5	P 79-0	12.98	155.95
DOUBLE BOTT NO. 6	P 79-0	12.98	155.95
DOUBLE BOTT NO. 7	P 79-0	12.98	155.95
DOUBLE BOTT NO. 8	P 79-0	12.98	155.95
DOUBLE BOTT NO. 9	P 79-0	12.98	155.95
DOUBLE BOTT NO. 10	P 79-0	12.98	155.95
DOUBLE BOTT NO. 11	P 79-0	12.98	155.95
DOUBLE BOTT NO. 12	P 79-0	12.98	155.95
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DOUBLE BOTT NO. 18	P 79-0	12.98	155.95
DOUBLE BOTT NO. 19	P 79-0	12.98	155.95
DOUBLE BOTT NO. 20	P 79-0	12.98	155.95
DOUBLE BOTT NO. 21	P 79-0	12.98	155.95
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DOUBLE BOTT NO. 43	P 79-0	12.98	155.95
DOUBLE BOTT NO. 44	P 79-0	12.98	155.95
DOUBLE BOTT NO. 45	P 79-0	12.98	155.95
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DOUBLE BOTT NO. 71	P 79-0	12.98	155.95
DOUBLE BOTT NO. 72	P 79-0	12.98	155.95
DOUBLE BOTT NO. 73	P 79-0	12.98	155.95
DOUBLE BOTT NO. 74	P 79-0	12.98	155.95
DOUBLE BOTT NO. 75	P 79-0	12.98	155.95
DOUBLE BOTT NO. 76	P 79-0	12.98	155.95
DOUBLE BOTT NO. 77	P 79-0	12.98	155.95
DOUBLE BOTT NO. 78	P 79-0	12.98	155.95
DOUBLE BOTT NO. 79	P 79-0	12.98	155.95
DOUBLE BOTT NO. 80	P 79-0	12.98	155.95
DOUBLE BOTT NO. 81	P 79-0	12.98	155.95
DOUBLE BOTT NO. 82	P 79-0	12.98	155.95
DOUBLE BOTT NO. 83	P 79-0	12.98	155.95
DOUBLE BOTT NO. 84	P 79-0	12.98	155.95
DOUBLE BOTT NO. 85	P 79-0	12.98	155.95
DOUBLE BOTT NO. 86	P 79-0	12.98	155.95
DOUBLE BOTT NO. 87	P 79-0	12.98	155.95
DOUBLE BOTT NO. 88	P 79-0	12.98	155.95
DOUBLE BOTT NO. 89	P 79-0	12.98	155.95
DOUBLE BOTT NO. 90	P 79-0	12.98	155.95
DOUBLE BOTT NO. 91	P 79-0	12.98	155.95
DOUBLE BOTT NO. 92	P 79-0	12.98	155.95
DOUBLE BOTT NO. 93	P 79-0	12.98	155.95
DOUBLE BOTT NO. 94	P 79-0	12.98	155.95
DOUBLE BOTT NO. 95	P 79-0	12.98	155.95
DOUBLE BOTT NO. 96	P 79-0	12.98	155.95
DOUBLE BOTT NO. 97	P 79-0	12.98	155.95
DOUBLE BOTT NO. 98	P 79-0	12.98	155.95
DOUBLE BOTT NO. 99	P 79-0	12.98	155.95
DOUBLE BOTT NO. 100	P 79-0	12.98	155.95
TOTALS		848	128125.95

SALT WATER BALLAST				
TANK	FRAMES	CENTER OF GRAVITY		GALL
		VCG (ABT)	LCG (ABT)	WEIGHT
FOREPEAK TANK	P 57M-115	20.58	14.91	552
DEEP TANK NO. 1	P 15-55	9.99	84.54	746
DEEP TANK NO. 1	P 15-55	9.99	84.54	746
DEEP TANK NO. 2	P 33-51	6.95	84.75	974
DEEP TANK NO. 2	P 33-51	6.95	84.75	974
DOUBLE BOTT NO. 1	P 31-79	2.57	155.95	472
DOUBLE BOTT NO. 1	P 31-79	2.57	155.95	472
DOUBLE BOTT NO. 2	P 79-0	2.58	155.95	999
DOUBLE BOTT NO. 2	P 79-0	2.58	155.95	999
DOUBLE BOTT NO. 3	P 79-0	2.58	155.95	999
DOUBLE BOTT NO. 3	P 79-0	2.58	155.95	999
DOUBLE BOTT NO. 4	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 4	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 5	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 5	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 6	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 6	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 7	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 7	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 8	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 8	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 9	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 9	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 10	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 10	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 11	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 11	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 12	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 12	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 13	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 13	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 14	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 14	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 15	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 15	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 16	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 16	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 17	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 17	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 18	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 18	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 19	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 19	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 20	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 20	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 21	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 21	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 22	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 22	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 23	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 23	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 24	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 24	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 25	P 155-149	2.64	400.95	4294
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DOUBLE BOTT NO. 26	P 155-149	2.64	400.95	4294
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DOUBLE BOTT NO. 28	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 29	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 29	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 30	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 30	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 31	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 31	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 32	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 32	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 33	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 33	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 34	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 34	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 35	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 35	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 36	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 36	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 37	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 37	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 38	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 38	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 39	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 39	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 40	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 40	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 41	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 41	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 42	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 42	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 43	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 43	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 44	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 44	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 45	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 45	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 46	P 155-149	2.64	400.95	4294
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DOUBLE BOTT NO. 49	P 155-149	2.64	400.95	4294
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DOUBLE BOTT NO. 50	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 50	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 51	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 51	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 52	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 52	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 53	P 155-149	2.64	400.95	4294
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DOUBLE BOTT NO. 56	P 155-149	2.64	400.95	4294
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DOUBLE BOTT NO. 57	P 155-149	2.64	400.95	4294
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DOUBLE BOTT NO. 58	P 155-149	2.64	400.95	4294
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DOUBLE BOTT NO. 59	P 155-149	2.64	400.95	4294
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DOUBLE BOTT NO. 60	P 155-149	2.64	400.95	4294
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DOUBLE BOTT NO. 61	P 155-149	2.64	400.95	4294
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DOUBLE BOTT NO. 62	P 155-149	2.64	400.95	4294
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DOUBLE BOTT NO. 63	P 155-149	2.64	400.95	4294
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DOUBLE BOTT NO. 64	P 155-149	2.64	400.95	4294
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DOUBLE BOTT NO. 65	P 155-149	2.64	400.95	4294
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DOUBLE BOTT NO. 66	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 66	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 67	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 67	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 68	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 68	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 69	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 69	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 70	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 70	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 71	P 155-149	2.64	400.95	4294
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DOUBLE BOTT NO. 72	P 155-149	2.64	400.95	4294
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DOUBLE BOTT NO. 73	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 73	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 74	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 74	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 75	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 75	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 76	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 76	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 77	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 77	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 78	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 78	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 79	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 79	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 80	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 80	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 81	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 81	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 82	P 155-149	2.64	400.95	4294
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DOUBLE BOTT NO. 83	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 83	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 84	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 84	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 85	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 85	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 86	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 86	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 87	P 155-149	2.64	400.95	4294
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DOUBLE BOTT NO. 88	P 155-149	2.64	400.95	4294
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DOUBLE BOTT NO. 89	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 89	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 90	P 155-149	2.64	400.95	4294
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DOUBLE BOTT NO. 91	P 155-149	2.64	400.95	4294
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DOUBLE BOTT NO. 92	P 155-149	2.64	400.95	4294
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DOUBLE BOTT NO. 94	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 94	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 95	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 95	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 96	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 96	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 97	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 97	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 98	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 98	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 99	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 99	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 100	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 100	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 101	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 101	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 102	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 102	P 155-149	2.64	400.95	4294
DOUBLE BOTT NO. 103</				

2054-00
Sheet 11 of 19
9-1-82 FJP

ARAPAHO FEASIBILITY DEMONSTRATION
HOST SHIP SPECIFICS

2064-00
 12 of 19
 9-1-82 PJP



Sheet 13 of 19
2064-00
9-1-82 PJP

GROSS WEIGHT

<u>LOAD</u>	<u>DESCRIPTION</u>	<u>LONG TONS</u>	<u>LBS</u>
1	02-QR-5	9.8	20,196
2	01-OP-4, 01-OP-6	13.95	20,100
3	01-OP-1, 01-OP-0, 01-OP-2	20.43	44,946
4	01-OP-7, 01-OP-5, 01-OP-3	20.63	45,386
5	OUTFITTING VAN	T.B.D.	
6	01-MN-4, 01-MN-6	14.99	32,978
7	01-MN-0, 01-MN-2	14.78	32,516
8	01-MN-3, 01-MN-1	14.78	32,516
9	01-MN-7, 01-MN-5	14.91	32,802
10	SPECIAL EQUIPMENT	T.B.D.	
11	"NO" DECK ADAPTERS	20	44,000
12	01-KL-4, 01-KL-6	15.12	33,264
13	01-KL-0, 01-KL-2	14.78	32,526
14	01-KL-3, 01-KL-1	14.90	32,780
15	01-KL-7, 01-KL-5	14.99	32,978
16	"LM" DECK ADAPTERS	20	44,000
17	01-IJ-2, 01-IJ-4, 01-IJ-6	20.63	45,386
18	01-IJ-3, 01-IJ-1, 01-IJ-0	20.54	45,188
19	01-IJ-7, 01-IJ-5	13.63	29,986
20	"JK" DECK ADAPTERS	20	44,000
21	01-GH-4, 01-GH-6	16.34	35,948
22	01-GH-0, 01-GH-2	13.75	30,250
23	01-GH-3, 01-GH-1	13.76	30,272
24	01-GH-7, 01-GH-5	18.4	40,480
25	"HI" DECK ADAPTERS	20	44,000
26	01-EF-4, 01-EF-6	15.66	34,452
27	01-EF-1, 01-EF-0, 01-EF-2	20.23	44,506
28	01-EF-5, 01-EF-3	16.18	35,596
29	01-CD-7, 01-EF-7	14.69	32,318
30	01-CD-4, 01-CD-6	15.34	33,748
31	01-CD-1, 01-CD-0, 01-CD-2	20.21	44,462
32	01-CD-5, 01-CD-3	16.04	35,288
33	02-C-6, 02-C-7	15.04	33,088
34	03-C-6, 02-C-5	17.16	37,752
35	03-C-5, 03-C-7	14.26	31,372

NOTE: THIS TABLE HAS BEEN DEVELOPED ON THE INCORRECT ASSUMPTION THAT 1 LONG TON = 2200 LBS.
FOR THE PURPOSE OF THIS CALCULATION, TJN HAS ASSUMED THAT THE VALUES FOR LONG TONS
ARE CORRECT, BECAUSE THEY SEEM TO COME FROM AN EARLIER STUDY.

Sheet 14 of 19
2064-00
9-1-82 PJP

LOAD	DESCRIPTION	GROSS WEIGHT	
		LONG TONS	LBS
36	02-DE-6	16.47	36,234
37	"FG" and "DE" DECK ADAPTERS	20	44,000
38	02-DE-7	14.69	32,234
39	03-DE-6	20.32	44,704
40	02-DE-5	18.37	40,414
41	03-DE-5	16.25	36,760
42	03-DE-7	16.18	36,618
43	02-FG-6	14.07	30,954
44	02-FG-7	12.57	27,654
45	03-FG-6	18.37	40,414
46	02-FG-5	15.31	33,682
47	03-FG-5	14.6	32,120
48	03-FG-7	17.21	37,862
49	04-C-6, 04-C-5	9	19,980
50	04-DE-6, 04-DE-5	18	39,600
51	04-FG-6, 04-FG-5	18	39,600
52	05-C-A HANGAR DOOR	8.49	18,678
53	05-C-C, 05-DE-A, 05-DE-B, 05-C-B	17.05	37,510
54	05-DE-D, 05-DE-E, 05-FG-A, 05-DE-C	16.36	35,992
55	05-FG-C, 05-FG-D, 05-FG-B	12.1	26,972
56	05-FG-E HANGAR DOOR	8.49	18,678
57	FUEL TANK 02-Q-3, 02-Q-1	5.9	12,980 E.W.
58	02-R-3	2.95	6,490

See note on preceding page

FUEL TANK VCB = 63.15'

05 LEVEL VCB = 60.41'
 04 LEVEL VCB = 78.70'
 03 LEVEL VCB = 73.65'
 02 LEVEL VCB = 65.15'
 01 LEVEL VCB = 52.9'

06 LEVEL VC6 - 00.44'
04 LEVEL VC6 - 70.70'
03 LEVEL VC6 - 72.65'
02 LEVEL VC6 - 65.15'
01 LEVEL VC6 - 52.9'

01 LEVEL

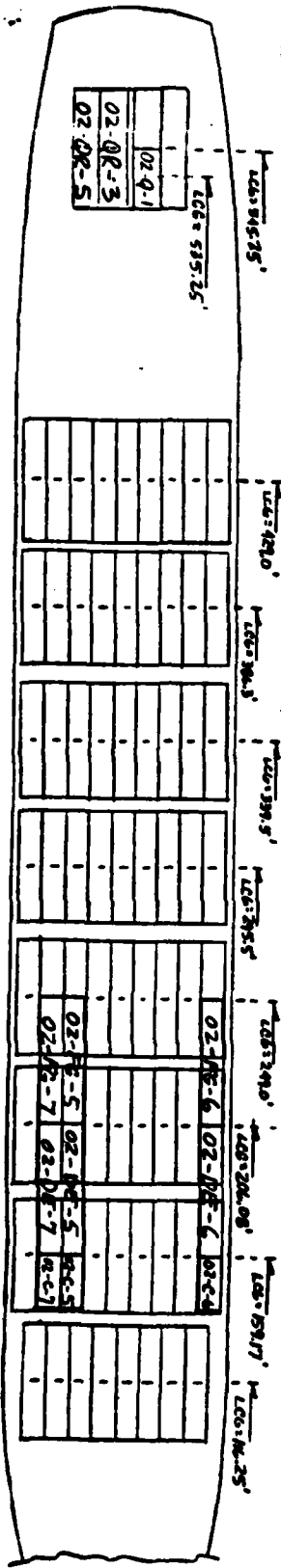
01-0P-6	01-NM-6	01-KL-6	01-EI-6	01-GR-6	01-FE-6	01-ED-6	
01-0P-4	01-NM-4	01-KL-4	01-EI-4	01-GR-4	01-FE-4	01-ED-4	
01-0P-2	01-NM-2	01-KL-2	01-EI-2	01-GR-2	01-FE-2	01-ED-2	
01-0P-0	01-NM-0	01-KL-0	01-EI-0	01-GR-0	01-FE-0	01-ED-0	
01-0P-1	01-NM-1	01-KL-1	01-EI-1	01-GR-1	01-FE-1	01-ED-1	
01-0P-3	01-NM-3	01-KL-3	01-EI-3	01-GR-3	01-FE-3	01-ED-3	
01-0P-5	01-NM-5	01-KL-5	01-EI-5	01-GR-5	01-FE-5	01-ED-5	
01-0P-7	01-NM-7	01-KL-7	01-EI-7	01-GR-7	01-FE-7	01-ED-7	

Sheet 16 of 19
2064-00
9-1-82 RJP

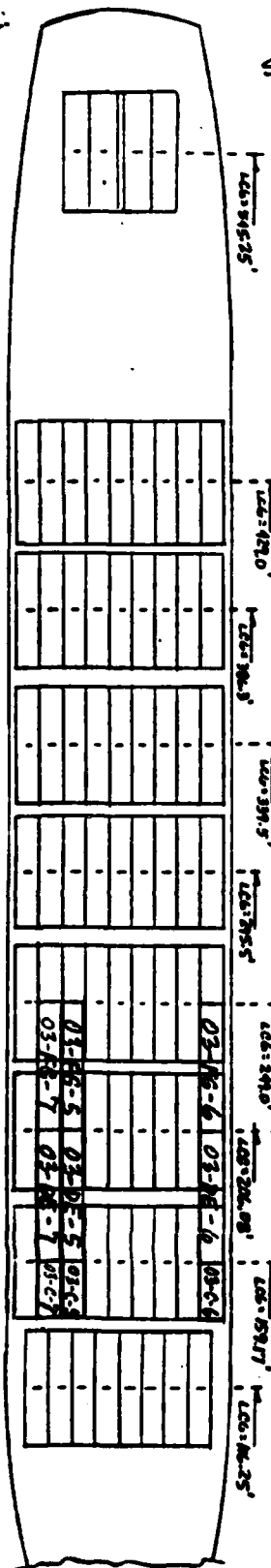
REL FROM VCB = 63.15'

05 LEVEL VCB = 80.44'
04 LEVEL VCB = 78.78'
03 LEVEL VCB = 73.65'
02 LEVEL VCB = 65.15'
01 LEVEL VCB = 58.9'

02 LEVEL



Sheet 17 of 19
2064-00
9-1-82 RJP



126'-84.25'

126'-02.0'

126'-36.8'

126'-39.5'

126'-75.5'

126'-34.0'

126'-20.08'

126'-59.17'

126'-14.25'

03 LEVEL

FUEL FROM VC6 = 63.15'

05 LEVEL VC6 = 80.44'
04 LEVEL VC6 = 78.78'
03 LEVEL VC6 = 71.65'
02 LEVEL VC6 = 65.15'
01 LEVEL VC6 = 58.9'

FUEL FROM VCG = 63.15'

05 LEVEL VCG = 80.44'

04 LEVEL VCG = 78.78'

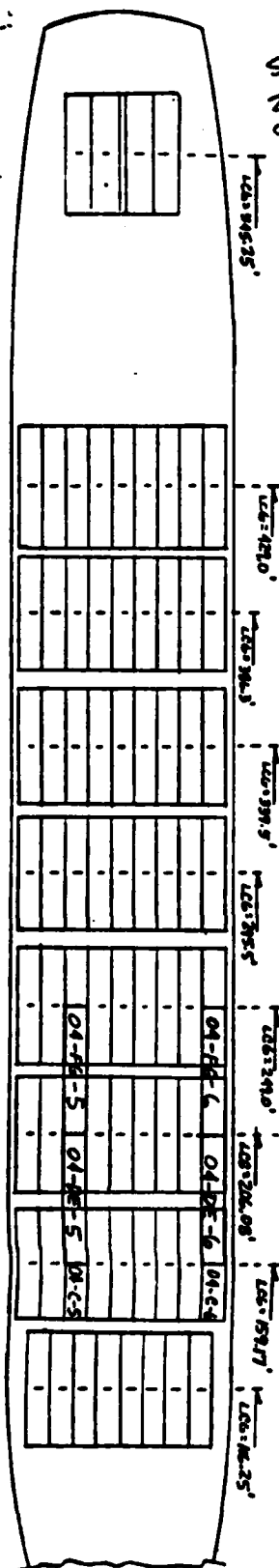
03 LEVEL VCG = 71.65'

02 LEVEL VCG = 65.15'

01 LEVEL VCG = 58.9'

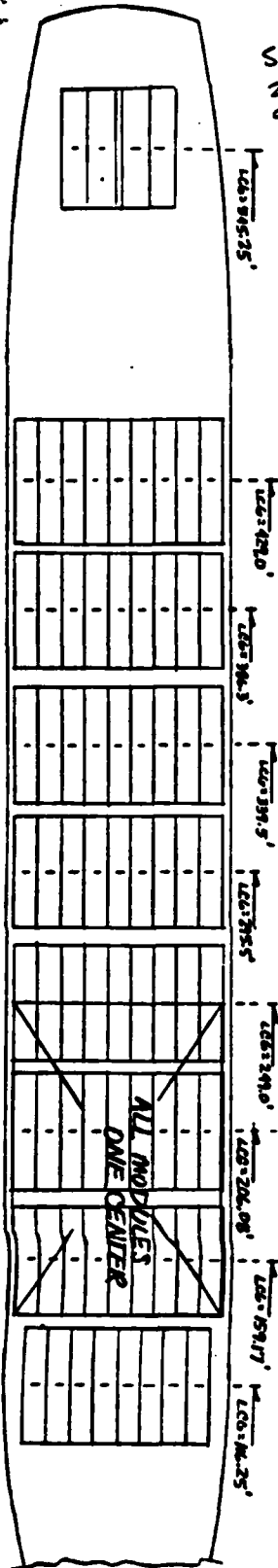
05 LEVEL VC6 - 80.44'
04 LEVEL VC6 - 78.78'
03 LEVEL VC6 - 73.65'
02 LEVEL VC0 - 65.15'
01 LEVEL VC6 - 58.9'

04 LEVEL



Sheet 19 of 19
2064-00
9-1-82 RJP

05 LEVEL



FUEL FROM VCB = 63.15'

05 LEVEL VCB = 80.44'
04 LEVEL VCB = 78.78'
03 LEVEL VCB = 73.65'
02 LEVEL VCB = 65.15'
01 LEVEL VCB = 58.9'

FILM

4-8